COLORED STONES

ASSIGNMENT 17

OPAL

IDENTIFICATION, PRODUCTION, MARKETING, BUYING

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I. INTRODUCTION

The fever that lures men from the comforts of the cities to burrow for opals in the rocks of Australia's hinterland is a chronic malady — a fever that a man never gets out of his system. The opal miner is a solitary, silent figure forever held by his fascination with the gem's flashing rainbow colors. His life is often one of hardship and privation. He tolerates bitter cold, intense heat, and inadequate supplies and facilities in the hope that his efforts will eventually be rewarded.

What prompts man to search for opal under such conditions? Why do many consider it to be the most beautiful and desirable of all gems? The answer lies in the fact that its beauty is unique: the flashes of fire from a fine opal produce an appearance found in no other gem and very few substitutes, an appearance that has intrigued and mystified man since ancient times. This fiery display of colors caused by light diffraction is a phenomena known as PLAY-OF-COLOR. It is the identifying characteristic of opal and its chief attraction as a gemstone.

Opal is an amorphous, hydrous form of silica ($SiO_2 \cdot nH_2O$). The amount of water (H_2O) present affects its R.I., as does any very small degree of crystallization into one of the several forms of silica. X-ray studies have shown weak cristobalite diffraction patterns in some opals.

In the mid-1960s researchers using an electron microscope proved that the internal structure of precious opal causes the play-of-color. They found that the diffraction of light from innumerable, regularly arranged, optically transparent spherical particles of amorphous silica and from the spaces or voids between these particles causes play-of-color. The spheres and the voids are arranged regularly in three dimensions (face-centered cubic) to form a three-dimensional diffraction grating. The important feature is that the spacing of the voids is the same as that of the spheres, and when this is about that of the wavelength of visible light, diffraction occurs. The angle through which the light is diffracted varies continuously with wavelength so that different colors appear at different angles, thus producing play-of-color. Only pure spectral colors can arise from this process. The size of the spheres and their spacing determines the color produced in the play-of-color. Spheres of a size that produce red "fire" can also produce all other spectral colors. However, the size spheres that produce blue or green can not produce any other color. Figures 1 and 2 were taken at about 20,000x magnification. Figure 1 shows the spheres; figure 2 illustrates the voids.

The historical background of opal is as colorful as the gem itself. Numerous quotations and references prove that it has been admired and treasured by mankind for centuries. The learned Roman scholar, Pliny, described opal as having "the fire of the carbuncle, the brilliant purple of the amethyst, and the sea-green color of the emerald, all shining together in incredible union." The Romans called opal *cupid paederos* (child beautiful as love) and revered it as the symbol of hope and purity. At that time opals were thought to preserve the wearer from disease. Eastern peoples held the gem in high esteem, regarding it as a sacred stone embodying the spirit of truth. The opal, Orpheus wrote, "fills the hearts of the gods with delight." The Arabs believed that opals fell from heaven in flashes of lightning and thus acquired their marvelous colors. In ancient Greece they were supposed to possess the power of giving

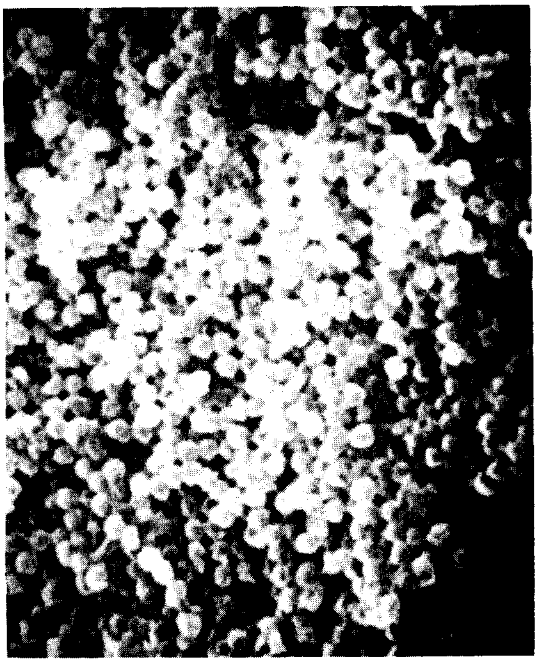


Figure 1

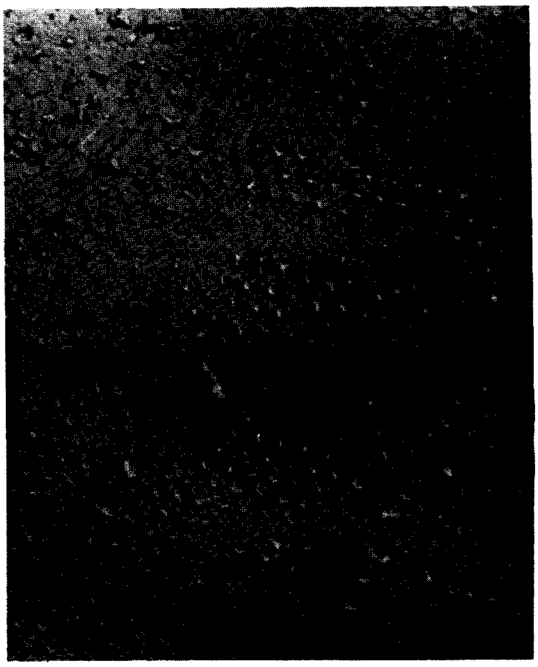


Figure 2

foresight and the light of prophecy to their owners. The Empress Josephine owned a gem that was called "The Burning of Troy" because of its dazzling play-of-color.

Later in history, the praises of opal continued to be sung. The great Elizabethans were among its most ardent admirers. "This miracle was the queen of gems," wrote Shakespeare in *Twelfth Night*. In Marlowe's *Jew of Malta*, an inventory of treasure begins: "Bags of fiery opals, sapphires, and amethysts; jacinth, topaz, and grass-green emeralds . . . ." The artist, Du Ble, offered this poetic description: "When nature had finished painting the flowers, coloring the rainbows, and dyeing the plumage of the birds, she swept the colors from her palette, and molded them into opals."

In the nineteenth century, a superstition about opal started when Sir Walter Scott wrote a novel called *Anne of Geierstein*, in which the heroine owned an opal that mirrored her every mood; it flashed red fire when she was angry and "burned ashen gray" upon her death. As a result some people began to believe that opal was unlucky. Fortunately, as public figures became known as opal fanciers or gave them as gifts, the superstition subsided. For example, Queen Victoria gave each of her five daughters a magnificent opal. Sarah Bernhardt, the illustrious French actress, was also instrumental in reestablishing the gem's popularity; it was her birthstone and she never considered herself well dressed unless she was wearing opal jewelry.

Opal alternates with tourmaline as the birthstone for October. The name of the species comes from the Latin *opalus*, which is from the Greek word *opalios*, which came from the Sanskrit word *upala* meaning precious stone.

A number of opals have become famous for their great size and beauty. The Devonshire Opal, for example, is a magnificent black opal specimen from Australia. It is oval and slightly convex in shape, measures 5.08 cm (2 in.) by 2.54 cm (1 in.) and weighs approximately 100 ct.

The Roebling Opal, a 2,610-ct, Virgin Valley, Nevada gem, is one of the largest masses of precious opal known; it is on display at the Smithsonian Institution, Washington, D. C. Also to be seen at the Smithsonian is the Roebling Black Opal, a 355.19-ct cabochon-cut black opal from Nevada, and the Dark Jubilee of 318.4 ct.

Another famous Australian stone, the Pandora Opal, weighs 711 ct, is 10.16 cm (4 in.) long, 5.08 cm (2 in.) wide, and nearly 2.54 cm (1 in.) deep. It is described as a good-quality, light colored stone with a deep red pattern that is interwoven with lightning flashes of brilliant yellow, green, and blue.

The Andamooka Opal, discovered in the Andamooka mines in South Australia, is a 205-ct, oval-shaped, green gem with red, orange, and blue play-of-color. The South Australian Government mounted it in a necklace and presented it to the Queen of England in 1954.

Still another famous Australian stone is the 233-ct Flame Queen. It is a black opal with a bright red center.

The Light of the World Opal is a fine, 273-ct, black specimen that was discovered in the early part of the present century in the Lightning Ridge district in New South Wales, Australia.

Museums in which one may see fine collections of opals include the Field Museum of Natural History, Chicago, Ill.; the Cranbrook Institute of Science, Bloomfield Hills, Michigan; the Cleveland Museum of Natural History, Cleveland, Ohio; the American Museum of Natural History, New York City; and the Smithsonian Institution, Washington, D. C.

II. VARIETIES AND TRADE NAMES

Opal may be classified in any of several ways. The most logical for the jeweler is to divide opal into two groups: gem opal and common opal. Gem opal is then described in terms of its background color and transparency. In addition, a number of terms are used to designate the dominance of various characteristics.

A. GEM OPAL

NUMEROUS TRADE NAMES BROADLY BASED ON BODY COLOR AND TRANSPARENCY EXIST. THE MOST IMPORTANT ARE:

1. White Opal

Semitranslucent to translucent stones showing a play-of-color against a white body color are called white opals. White opals are usually simply referred to as Australian, regardless of source. Fine qualities are sometimes called White Cliffs opal after the Australian opal field of that name. Those with a milky white body color are sometimes called milk opal.

2. Black Opal

Opals with a play-of-color against a black or dark gray body color are called black opals. Those with dark blue, green, brown, or other dark body colors are also called black opal when a vivid play-of-color is also present. The term is less correctly used for stones with light gray body colors.

3. Crystal Opal

These are colorless and transparent to semitransparent with play-of-color. Figure 12 of the attached color photographs is crystal opal.

4. Fire Opal

Transparent to semitransparent specimens with yellow, red, orange, or brown body colors both with and without play-of-color are known as fire opals. However, some people reserve this term for those stones without play-of-color; such stones are frequently faceted. All types of fire opal, both with and without play-of-color, are frequently referred to as Mexican opal. Those with a red body color are also called cherry opal. Figures 8 and 11 of the attached color photographs are fire opal.

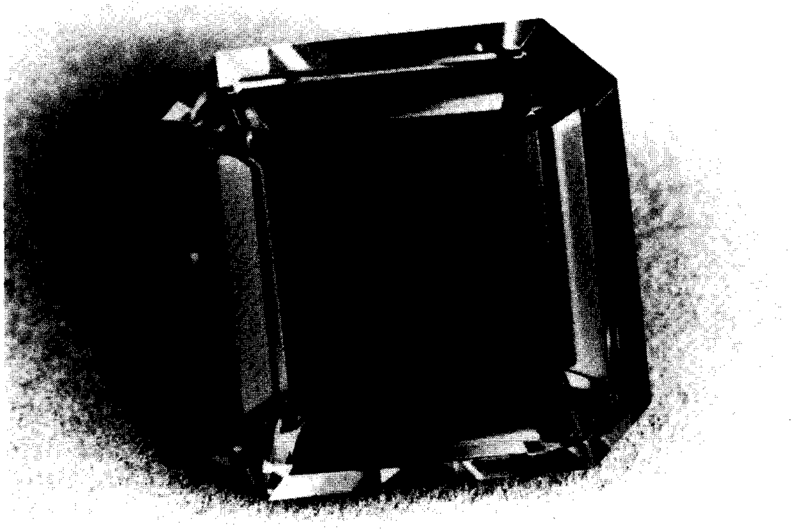


Figure 3 FACETED FIRE OPAL WITHOUT PLAY-OF-COLOR

5. Jelly or Water Opal

The colorless, transparent to semitransparent stones with little or no play-of-color are called water opal or jelly opal.

6. Boulder Opal

Thin seams of opal with a play-of-color that occur in ironstone matrix in Australia are called boulder opal. These stones are usually cut with the opal on top so that the ironstone matrix serves as a strong backing for the opal; these stones often resemble doublets.

7. Matrix Opal or Opal in Matrix

Stones that have thin seams of opal with play-of-color randomly scattered throughout ironstone matrix or have spots of opal with play-of-color interspersed throughout a rhyolite matrix.

THE FOLLOWING ARE TRADE NAMES BASED ON THE SIZE, SHAPE, AND PATTERN OF THE COLOR PATCHES:

1. Pinfire or Pinpoint Opal

Opals with small close-set color patches are called pinfire or pinpoint opal. The small pinpoints can be any color, but red is the most desirable. Figure 9 of the attached color photographs is an example of white pinfire opal.

2. Harlequin or Mosaic Opal

These stones have play-of-color in regular, angular, close-set patches. Figure 1 of the attached color photographs is an excellent example of harlequin opal.

3. Flame Opal

This term is used to describe opals that have sweeping reddish bands or streaks of color that shoot across the stone much like wind-blown flames. Figure 4 of the attached color photographs is of flame opal.

4. Flash Opal

Opals in which the play-of-color shows in sudden flashes that quickly disappear or change as the stone is moved are called flash opal. The flashes may be of any color, but red is the most desirable. Figure 2 of the attached photographs is an example of flash opal. However, it is not possible to show the effect of the colors changing or disappearing in a photograph or when both the stone and the observer are stationary.

TRADE TERMS BASED ON THE HUE OF THE PLAY-OF-COLOR

1. Peacock Opal

Stones in which the play-of-color resembles a peacock's feathers. Opals that have blue, green, and purple or any two of these colors are called peacock opal.

2. Lechosos Opal (pronounced lay-CHO-sos)

A term used for opal showing a green play-of-color only.

TRADE TERMS BASED ON APPARENT PHENOMENA OF THE PLAY-OF-COLOR

1. Cat's-eye Opal

A rare variety in which the play-of-color produces the appearance of a colored chatoyant band.

2. Star Opal

A very rare variety in which the play-of-color gives the appearance of asterism.

TRADE TERMS BASED ON THE STRUCTURE OR TEXTURE OF THE MATERIAL

1. Opalized Bone

This is bone that was replaced by opal. It is dark brown, opaque, and has small patches of play-of-color in the cellular structure of the bone. It is sometimes called "Greek opal."

2. Opalized Wood

This type may or may not have play-of-color, but it is characterized by the cellular structure of the wood that was replaced by opal.

3. Opalized Shell

This type retains the shape and structure of a shell that was replaced by opal. It usually has a play-of-color.

4. Oolitic Opal

In this stone, the play-of-color acts as a background for numerous black or brown spherical inclusions that have the appearance of roe (fish eggs) and are scattered throughout the stone.

B. COMMON OPAL OR POTCH

This category includes all opals without play-of-color except fire opal. Common opal occurs in every possible body color and varies from translucent to opaque. Very little of this material is suitable for use as a gemstone. Potch is a term used frequently in the Australian opal fields to describe common opal without play-of-color.

1. Prase Opal

Translucent to opaque green common opal. The word is from the Latin *prasius*, which is from a Greek word meaning "leek green."

2. Moss Opal

A type that closely resembles dendritic agate.

3. Cachalong Opal

A bluish white, porous, translucent to opaque, porcelain-like type of opal. The name is adapted from *kaschtschilon*, a word of Tartar origin.

4. Girasol Opal

This type shows a moving, billowy light effect. It is almost transparent and the body color is milky white or very light tones of various hues. It resembles a poor-quality moonstone. The term girasol originated from the Italian words *girare* (turn) and *sole* (sun).

5. Hyalite or Muller's Glass

This type ranges from transparent and colorless to translucent and white. The name hyalite is derived from a Greek word meaning "glass."

6. Hydrophane or "Magic Stone"

A kind of common opal that must be immersed in water or heated in oil, so that the water or oil penetrates the stone and produces a play-of-color. The name originated from a Greek word meaning "apparent in water."

7. Wood Opal

This variety is dark brown to black and opaque.

C. ASSEMBLED OPALS

1. Floating Opal

These are assembled stones made of small, broken pieces of gem opal that are placed in liquid filled transparent glass or plastic containers. The liquid is often glycerin or a glycerin and water mixture.

2. Opal Doublets

If a section of opal is too thin to use as gemstone, it may be cemented with black adhesive to a piece of chalcedony, glass, or potch opal. Such stones are often exceptionally lovely. Less commonly, a thin piece of opal is cemented into a shallow depression in a piece of black chalcedony. These are very attractive stones since the black border contrasts sharply with the opal center. In less expensive stones of this kind, opal chips are cemented into the depression, then the whole assembly is ground and polished so the top surface is flush.

3. Painted Opal

Sometimes the back of transparent to translucent opal is painted black to improve the appearance of the stone and simulate black opal.

4. Opal Triplet

These are assembled stones consisting of a base of potch opal, chalcedony, or other material, a thin layer of gem-quality opal, and a top of colorless quartz. They resemble opal doublets except that they have a quartz top which adds durability and protects the softer opal from being scratched. Some triplets have been made using glass instead of quartz, but they are not as durable. Although most triplets have glass or quartz tops, any transparent material could be used as the cap for an opal triplets.

D. TREATMENTS

1. Sugar Treated Black Opal

Frequently, low grade porous opal (usually from Andamooka, Australia) is sugar treated to darken the stone and give the appearance of black opal. This material is opaque, and prior to treatment the play-of-color is almost indistinguishable from the background. The stone is first heated and soaked in a sugar solution or a fruit juice that is high in sugar content (e.g., orange or grape juice). When the stone is dried, the sugar remains. The stone is then immersed in a concentrated sulphuric acid solution that carbonizes (blackens) the sugar to create a dark background for the play-of-color. Sugar treated opal has a characteristic "peppery" appearance that distinguishes it from "smoked" opal. Usually only cut stones are treated, since the treatment is only as deep as the liquid can penetrate, and cutting could remove the black color.

2. Smoke Treated or "Smoked" Opal

An extremely porous, light beige opal that has a nice play-of-color occurs in Jalisco, Mexico. This and other poor-quality material can be smoke treated to resemble the finest Australian black opal. When opal is smoke treated, it is first wrapped in paper or combined with dried manure and placed in an earthen pot. The pot is then heated on a bed of charcoal until the paper or manure gets hot enough to smoke and char. Since the smoke treatment does not penetrate deeply into the stone, the black color is confined to the surface.

3. Plastic Treated Opal

In the late 1970s some very attractive opal, apparently from a new source, appeared on the market in America. The stones were unlike previously encountered black opal in that they were much more transparent than most black opal and seemed to have inclusions somewhat akin to the wisp- or veil-like inclusions seen in flux-grown synthetic emeralds. When these opals were etched and the surfaces examined with a scanning electron microscope, it was clear that the opal had been impregnated with a dark plastic. Presumably this process involves the use of a vacuum to help the plastic penetrate the opal. Because the plastic is usually colored, the finished product is darker and closely resembles black opal. Most of this material originally came from Brazil.

III. MODE OF FORMATION

Opal is formed from silica bearing solutions at low temperatures. It may be deposited late in the cooling of igneous rock or during the alteration or weathering of silica bearing metamorphic and other rock types, or it may be a sedimentary deposit resulting from a concentration of silica gel in an evaporating body of water. Sedimentary deposits often replace wood, shells, or skeletal animal remains.

In Australia, opal occurs in a number of different forms: in boulders of sandstone at depths of 1 to 10 or 12 meters (BOULDER OPAL); in layers of varying thickness between common opal; as a filling in cavities in sandstone, lava, clay, or other rock. Gem-quality opal is usually found in sedimentary deposits in thin bands or seams (SEAM OPAL). Large stones are uncommon. In Mexico, opal occurs filling vesicles in rhyolite.

IV. SOURCES AND RECOVERY METHODS

(Note: The numbers in parentheses in this portion of the text refer to appoximate locations of sources on the accompanying maps.)

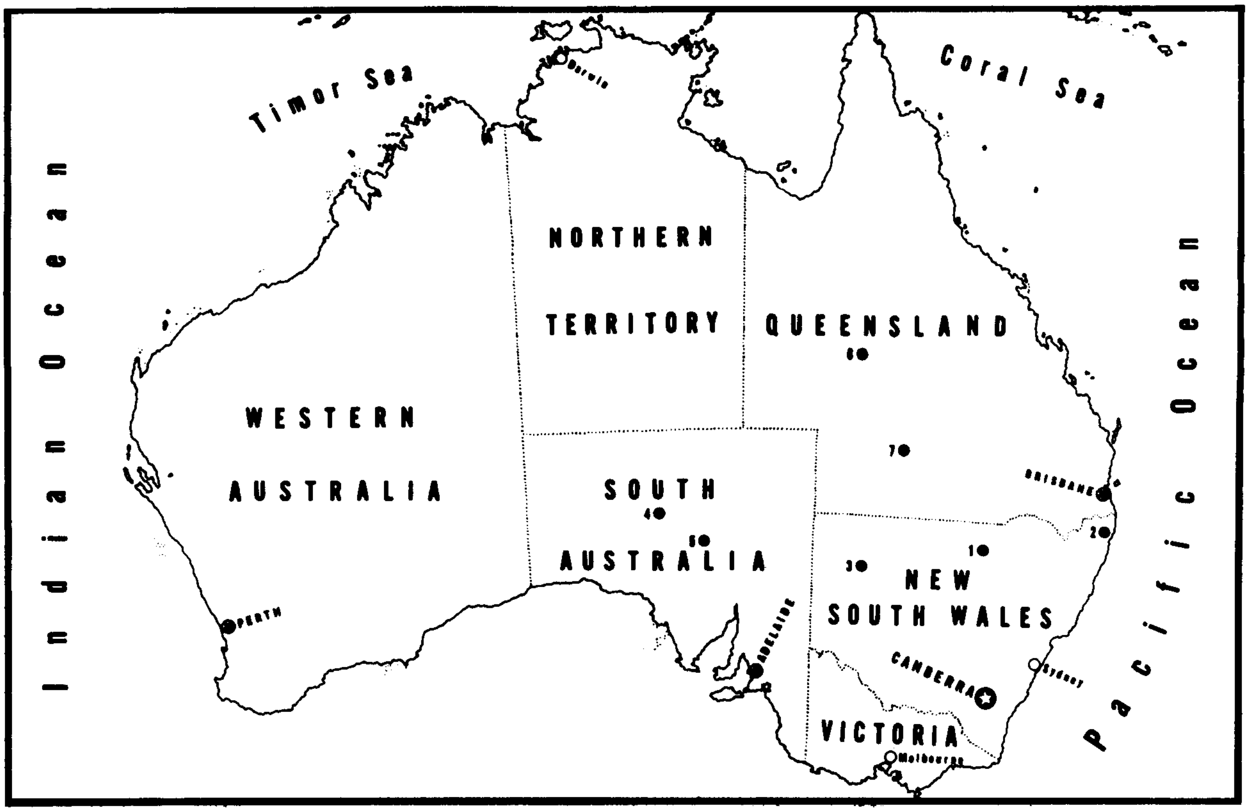
A. AUSTRALIA

Although opals are mined in many regions of the world, Australia is by far the most important source. The mining regions are located in New South Wales, South Australia, and Queensland.

Both black and white opal are mined in three general areas of New South Wales. The most famous of these is the Lightning Ridge district (1) where black opal was first mined commercially about 1905. This field lies approximately 96 km (approximately 60 mi.) north-northwest of Walgett, a total distance of about 800 km (approximately 500 mi.) from Sydney, and includes another important producer, the Grawin field which opened in 1926. At Lightning Ridge, the opal occurs as seams in sandstone or as nodules in a sandy clay. Depending on the topography, the opal beds may outcrop or be as much as 30 m (approximately 100 ft.) below the surface.

In the Tintenbar district near Linsmore (2), opal occurs as loose fragments in the soil and in seams and veins in basalt.

The White Cliffs area (3), which is the oldest of the recognized fields in the industry, began production in 1889 shortly after a hunter picked up a fine white opal specimen while trailing a wounded kangaroo. This field is located about 96 km (approximately 60 mi.) north-northwest of Wilcannia. Here the gem opal is usually found as small veins in common opal.



The most important producing region in South Australia is Coober Pedy (4) which is an aboriginal name meaning "white man in a hole," an allusion to the fact that almost everyone there lives in dugouts. This field, which is located in the Stuart Range about 110 km (70 mi.) west of Anna Creek Station and about 960 km (approximately 600 mi.) from Adelaide, was discovered in 1915. Only white opals are produced in this locality; they occur in sandstone and claystone. In 1930, opal was found at Andamooka Station (5), west of Lake Torrens. At one time, the combined output of Coober Pedy and Andamooka represented approximately 95% of the world's production of gem-quality opal.

The discovery of the Coober Pedy field and the living conditions of the miners and their families is an interesting sidelight. A prospector and his son set off overland from South Australia to Western Australia in search of gold. While camping one night in the Stuart Range, the son picked up a stone and threw it at a camel. The boy was entranced as it curved through the air in a flashing, sparkling arc toward the camel's back. He took the stone to his father who showed it to a geologist. The expert told him that it was not a valuable find — it was what mining men called a "floater," but that he thought it was an indication that there was valuable material in the vicinity.

So a party of six men and their camels started off. They lost their camels only a few miles from a lake bed where they had decided to dig and had to continue the journey on foot. They had not gone far when they met two men with a horse and cart. These men had discovered the Coober Pedy field, worked six months for a profit of $100,000, and decided to leave. So the first "gougers" (local term for opal miners) moved out; the incoming team moved in and the township of Coober Pedy was off to a flourishing start.

Coober Pedy is one of the few places in the world that has no housing shortage because, as mentioned above, almost everyone lives in dugouts. In the boom years before World War II, the population was about 400. Today the local citizens do not mind how many people want to rush there. To construct a house it is merely necessary to go to work with a stout heart, a strong back, and a pick and shovel. You don't need bricks or timber; in fact, the furniture of most Coober Pedy homes is carved out of the walls.

The first dwellers chose to live in holes in the ground as a matter of necessity. The later inhabitants have stayed there out of preference, because below the surface they have protection against the vagaries of the climate. In the summertime the thermometer rarely drops below one hundred degrees Fahrenheit; in the winter thick frosts cover the ground, and underground the temperature is always more tolerable. Most of the dugouts are equipped with cooking stoves and are fairly comfortable, see figure 4. A few have electric lighting that is powered by wind driven generators, and

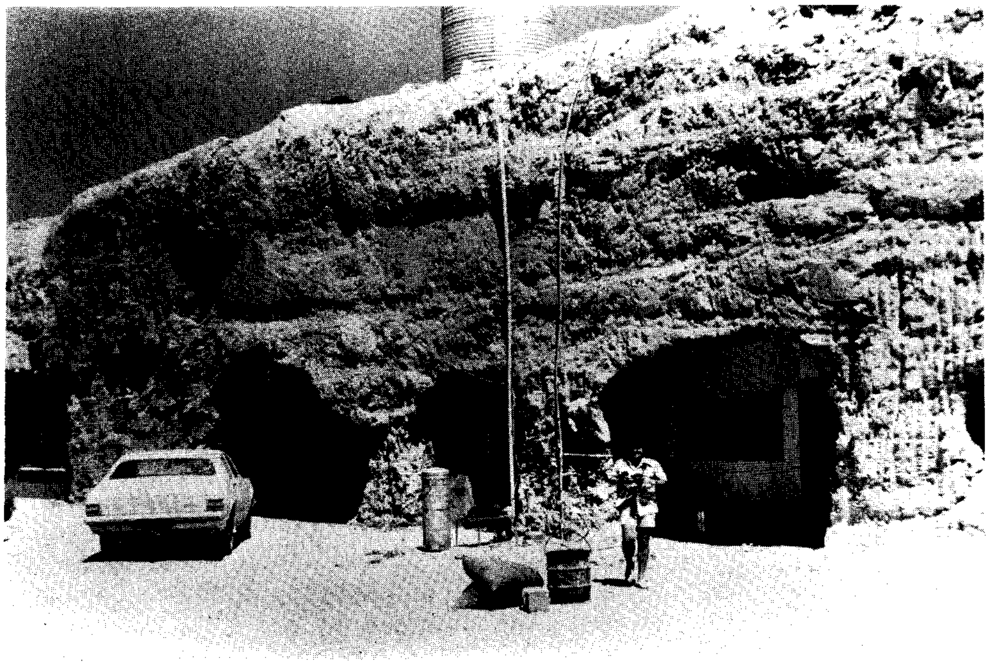


Figure 4 PHOTO BY RICK SHAW

some even have kerosene refrigerators. Some miners bring their families to live on the field, but those with children try to move away during the worst of the summer.

The production from Queensland falls considerably below that of New South Wales and South Australia. Most of the deposits are close to the surface in sandstone or iron-bearing claystone. A large district in western Queensland is known to contain opals, but mining activity has been restricted to only a few localities such as the Opalton field (6); these localities yield white opal. Black opal is known to occur in one area near the southern boundary, notably the Hayricks Mine, near Quilpie (7).

Prospecting and mining for opals in Australia is a hazardous and highly speculative venture. Not only are the deposits spread over a wide area, but there is little to guide the prospector to areas rich enough to pay. Surface indications, when they are found, consist of bits of weathered and disintegrated opal which are called "colors" or "color floaters." These indications are followed until the vein is located. Sometimes, however, prospectors merely dig at random and hope for a lucky discovery.

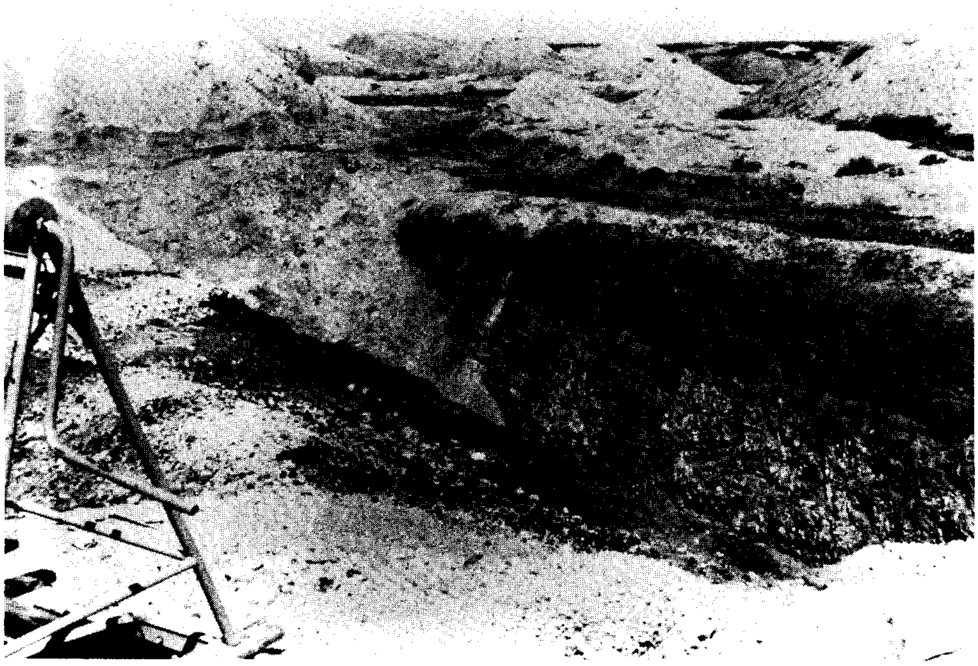


Figure 5 PHOTO BY RICK SHAW

The mining itself is essentially a small scale surface proposition (see figure 5); few large scale operations prove remunerative. Some of the Australian deposits lie very close to the surface and can be worked entirely by trenching methods. Usually a pit is sunk until the opal bearing stratum (called "hard band" or "steel band") is reached, then the digging continues through to the soft layer (known as "opal dirt") that usually lies underneath. A tunnel is extended into the opal bearing layer and the gems are removed from both the roof of the hard band and from the softer opal dirt (see figure 6). The valuable material is extracted from the hard material with a pocketknife, screwdriver, or similar tool. Any necessary trimming is done with a pair of pliers; then the material is ready for sale as rough stones.

Figure 6 PHOTO BY RICK SHAW

Climate is the most important single factor that affects production. The principal fields are situated in isolated and arid regions (see figure 7), and even when other conditions are favorable, the intense heat, scarcity of water, and associated difficulties of the summer months induce many miners and their families to move nearer the coast for that season. If prolonged drought and other abnormal circumstances are superimposed on the naturally adverse conditions, the number of men leaving a field and the length of their absence increases, and production declines markedly. The effects of one or two drought years may extend over a much longer period, since some men find other employment and do not return to opal mining.

The physical difficulties of prospecting in dry and inhospitable areas are formidable, and prospectors must be equipped to remain away from a supply base for more than a few days. Miners who are financially able to purchase good equipment naturally prefer to remain near the field where they have made money or to give up opal mining altogether, whereas others who would be prepared to go prospecting cannot afford the necessary equipment. Thus, very little of the money earned during a boom period is used in developmental work or for further prospecting, and as soon as a rich patch is worked out there is a recession in the general level of production until another fortuitous discovery is made. Until some means are devised of overcoming this pattern, it is unlikely that demand and production will be related.

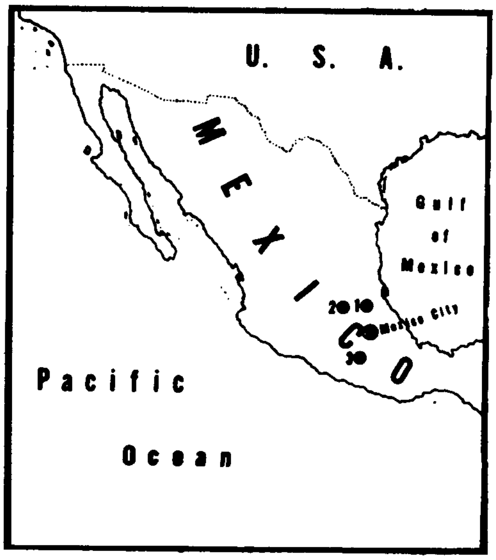
Figure 7 PHOTO BY RICK SHAW

Although a few lapidaries are engaged in cutting and polishing opals in the fields, especially at Lightning Ridge, most of the rough material is sold to buyers who visit the mines periodically or to resident agents who act on behalf of city buyers. Business is transacted on a cash basis. Sydney is the center of the cutting and polishing industry, but lapidaries are also established in Melbourne, Brisbane, and Adelaide.

B. MEXICO

Mexico is noted for its fire opal and water opal, some of which are very beautiful and desirable. The original source at Zimapan, in Hidalgo (1), is now virtually worked out. Fire opal is also found in the State of Queretaro (2), and in the State of Guererro, near Huitzuco and San Nicolas (3). Other Mexican states, including Chihuahua, produce small quantities.

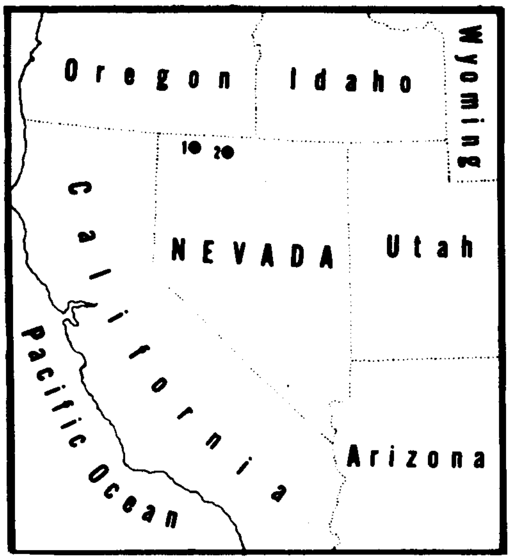
An opaque, creamy white variety of opal found in Jalisco, Mexico, is sometimes "smoked" to improve its appearance (see Section II, D, 2. Smoke Treated or "Smoked" Opal).



C. BRAZIL

Numerous alluvial workings for gem opal are found in the Pedro II area Piaui, Brazil. However, the in situ mining at Boi Morto appears to be the most efficient. Piaui, Brazil is one of the most important sources of opal outside of Australia. This material closely resembles the Queensland type of opal.

D. UNITED STATES



Some fine opals have been mined in the United States. The most important source is Virgin Valley which is situated in Humbolt Co., Nevada, near the Oregon border (1). This deposit was discovered in 1908. A variety of opals ranging from almost colorless, transparent gems to the prized black type with vivid flashes of red, blue, and green have been found here. It is largely a desert region where the opals occur associated with petrified wood in beds of volcanic ash. Sometimes the cracks in a piece of petrified wood are completely filled with flashes of red and blue. Occasionally, whole opalized twigs are found.

Unfortunately, these stones have a tendency to crack after being mined and exposed to the air, a condition apparently caused by the sudden loss of moisture that characterizes Nevada opals. The deterioration usually begins with shrinkage that

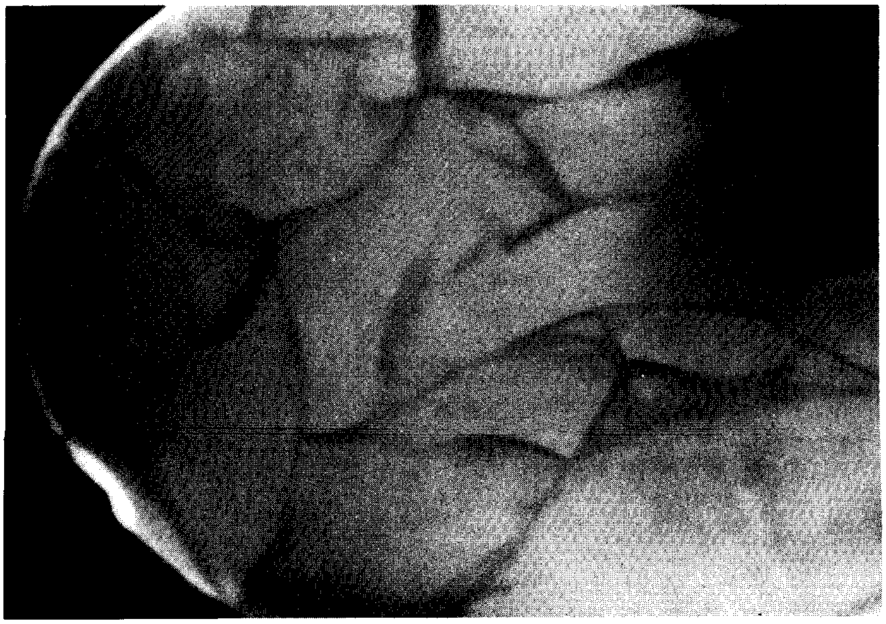


Figure 8 CRAZING IN OPAL

produces a network of fine, shallow cracks on the surface. This condition is known as CHECKING or CRAZING. As the drying continues, the cracks become deeper and finally the stone breaks.

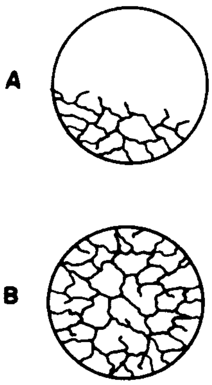


Figure 9

Figure 9a shows partial checking; figure 9b illustrates the appearance of a stone in which checking extends over the entire surface. If the checking marks are removed by repolishing, complete breakage may be avoided. Of course this condition can occur in opals from any source, but it is a major problem with Nevada opals. To prevent breakage, the gems are sometimes buried for several months or years in the belief that this will allow them to lose moisture slowly and be "tempered". This "cure" is seldom successful, however.

Another Nevada locality lies approximately 80 km (50 mi.) north of Winnemucca (2). The gems here also show a wide color range, but deterioration is an even greater problem than with those from Virgin Valley. A deposit of opal in basalt has also been worked at Paradise Valley, Nevada.

There are several deposits of opal in Washington, particularly near the southern boundary. Although a number of gems have been discovered in the past, the deposits are of little or no commercial importance.

Deposits of some value have been found near Ft. Bayard, New Mexico; in the Owyhee Range, Owyhee County, Idaho; near Johannesburg, California; in San Bernardino County, California; along Ochoco Creek, Crook County, Oregon; near Alpine, Texas; and in Clark and Latah Counties, Idaho. Most of these occurrences are of academic interest only, but the one at the Spencer mine in Clark Country, Idaho has produced good quality opal in fair quantities, even though it is operated on a dig it yourself basis. Star opal comes from this locality.

E. CZECHOSLOVAKIA (HUNGARY)

Since boundaries were revised after World War I, the famous old "Hungarian" Mines now lie in Czechoslovakia. The center of mining was at Czerwenitza, east of Presov. At one time Hungarian stones were well known in the trade; for more than two centuries most of the fine white opals came from this source. The gem material occurred in cavities in igneous rock, associated with common opal, pyrite, and marcasite. Hot springs are still active in the vicinity. The discovery of opals in Australia reduced prices until finally, in about 1920, mining at the Hungarian deposits virtually ceased. The Czerwenitza mines were worked so long and so thoroughly that they are practically worked out. Present production is neglible.

F. HONDURAS

Opal occurs as irregular veins in trachyte (an extrusive igneous rock) in the department of Gracias, especially near Gracias a Dios, Intibuca, and Erandique. The material is similar to Australian white opal and often of good quality, but the deposits are somewhat inaccessible and little information concerning them is available.

G. OTHER SOURCES

Opal has been reported from a number of other localities throughout the world. It occurs as small pieces of little value in an altered trachyte at Faratsiho in Madagascar, in rhyolite in the Tairna District on the Haurake Peninsula in New Zealand, in the State of Carabobo in Venezuela, and from Tarakasaka and Hosaka in Japan.

V. FASHIONING

Except for fire opal and water or jelly opal, which are sometimes faceted, all opal is cut en cabochon, either flat, lentil, or double, or it may be carved. Seam opal can be fashioned by two different methods (see figure 10), the nature of the matrix in which the seam is embedded determines which of the two methods will be used. If the matrix material is sandstone that is too soft to provide a backing for the opal, the decision is to make a doublet.

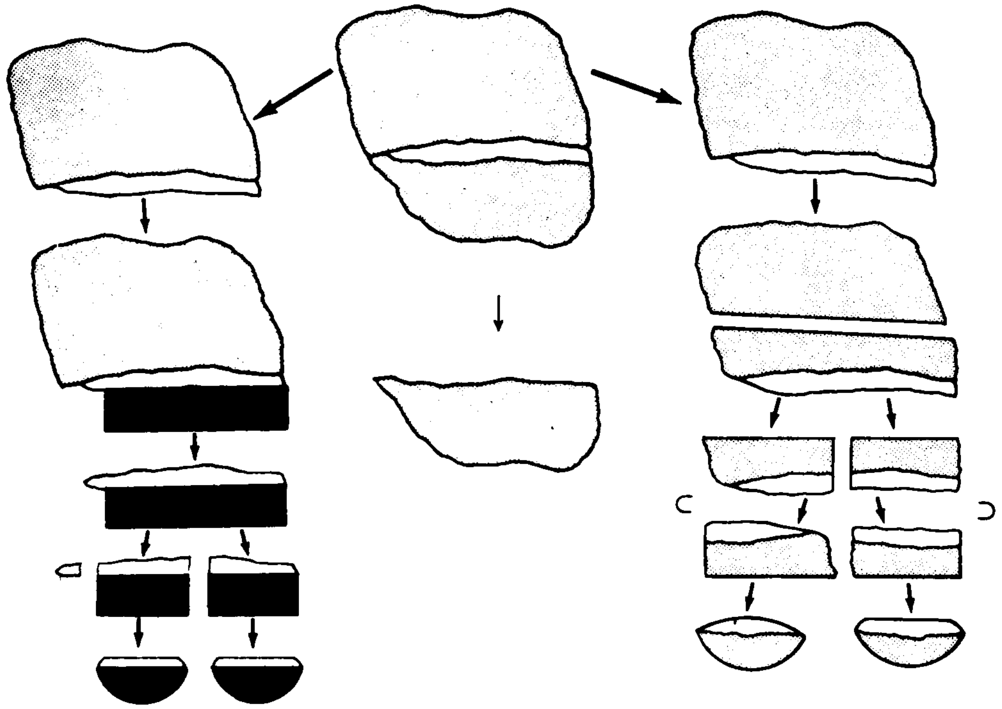


Figure 10a

Figure 10b

This process is shown in figure 10a. First the sandstone is removed from one side of the opal seam. Next the exposed surface is ground flat and a piece of backing material (either chalcedony, glass, or potch opal) is cemented to the flat portion of the opal seam. This cement, which is usually black pitch, serves two purposes: it provides a dark background that makes the play-of-color in the finished stone more noticeable, and because it never completely hardens, it acts as a cushion for the thin piece of opal.

Then the remainder of the sandstone matrix is removed, the cemented piece is sawed in two, and the excess trimmed off. In the final phase the top and bottom portions have been cut and polished into finished opal doublets.

If the matrix consists of ironstone instead of sandstone, the stone is cut with the matrix as a backing material (figure 10b). First the matrix is ground away from one side of the seam. Then the excess matrix is sawed off, and the piece is sawed in two. The last diagram illustrates the final result of cutting and polishing. The resultant stone is called BOULDER OPAL. On the other hand, if a stone is fashioned from a piece of rough that consists of small veins of opal scattered at random throughout the matrix, it is called OPAL IN MATRIX.

Since opal may be damaged by heat or shock of any kind, it must be cut with great care. Sawing should be done with a very thin blade that is kept cool at all times. Use only fine grit wheels for grinding; not only does opal grind away very rapidly, but sandstone matrix spots may cause serious undercutting. Sanding is best accomplished with a worn sander or a very fine sanding cloth. To polish cabochons, use a felt wheel with tin oxide or cerium oxide; either of these agents on a lucite or tin lap is satisfactory for faceted stones.

VI. PHYSICAL AND OPTICAL CHARACTERISTICS

Physical

Chemical Composition	Silica with varying percentages of water (usually 3% to 10%, nearer the upper figure in fine quality), expressed by the formula $SiO_2 . nH_2O$.
Crystallographic Character	Amorphous; however, some opals have proved to be partly crystalline.
Cleavage	None
Fracture	Conchoidal
Hardness	5 to 6½
Toughness	Variable; very poor to fair. Opal is *too fragile* to be recommended for a man's ring. Although satisfactory

for a woman's ring, you should warn an owner to avoid sharp blows.

Streak	White to grayish.
Specific Gravity	1.25 to 2.23; normal, 2.15.

Optical

Degree of Transparency	Transparent to opaque.
Luster	Polished surfaces are vitreous; fracture surfaces are subvitreous to waxy (the latter is more typical of common opal).
Phenomena	Play-of-color. Iridescence, caused by diffraction, is sometimes exhibited in some Mexican opal.
Characteristic Inclusions	Matrix consisting of sandstone, common opal (potch), quartz, or other materials, particularly in Mexican material.
Pleochroism	None
Refractive Index	1.37 to 1.47; usually, 1.45. Mexican opal may read as low as 1.37, but it is generally 1.42 to 1.43.
Birefringence	None
Dispersion	Very low.
Optic Character	Singly refractive. Because of strain, transparent stones often exhibit anomalous double refraction.
Ultraviolet Fluorescence	Black and white opal: moderate to strong pale blue, green, or yellow. Common opal and hyalite: moderate to strong green or yellowish green. Fire opal: very weak to moderate greenish brown. All of these colors are produced by either long or short wavelengths but stronger to long-wave. Many Australian white opals, as well as a few from other localities, phosphorous after the U.V. is turned off. Brazilian opal fluoresces very weakly, if at all.
Color-Filter Reaction	None

Absorption Spectra	None

(Note: Although the equipment necessary for X-ray testing is not readily available to most gemologists, the results of such testing are listed for the sake of completeness.)

X-Ray Fluorescence	None
Transparency to X-Rays	Semitransparent

Effects Caused By:

Heat	Sudden changes in temperature may cause opals to crack, craze, or fracture; in addition, some are very porous. Thus, although it is common practice to repolish the tops of worn cabochons while they are mounted, they should be removed for any other repair work. Opals should never be placed in a boiling solution nor cleaned in other than mild, soapy, lukewarm water. Overheating will turn most opals white or brownish and the play-of-color may disappear, in which case it cannot be restored. The very porous opal from Jalisco, whether treated or not, will turn black and lose its play-of-color when wet. However, when it drys out again, the play-of-color will return.
Acids	Attacked rapidly by hydrofluoric acid.
Irradiation	No known effect.

VII. SUGGESTIONS FOR TESTING

A. SEPARATION FROM OTHER MATERIAL

The most difficult separation is between natural and synthetic opal. Synthetic white opal began to appear on the market in 1974. It was soon followed by synthetic black opal. Synthetic opal has the same chemical composition and structure as natural. The R.I. is usually 1.44 ± .01 and the S.G. about 2.00 ± .03. There is no X-ray fluorescence, and the ultraviolet fluorescence is essentially the same as natural opal. However, synthetic white opal does not phosphoresce while most natural white opal, except Brazilian, will phosphoresce for several seconds after the L.W. U.V. is turned off. Synthetic black opal fluoresces very weakly, if at all, and there is no phosphorescence. In addition, synthetic opal is much more transparent to ultraviolet radiation (especially long-wave) than natural opal.

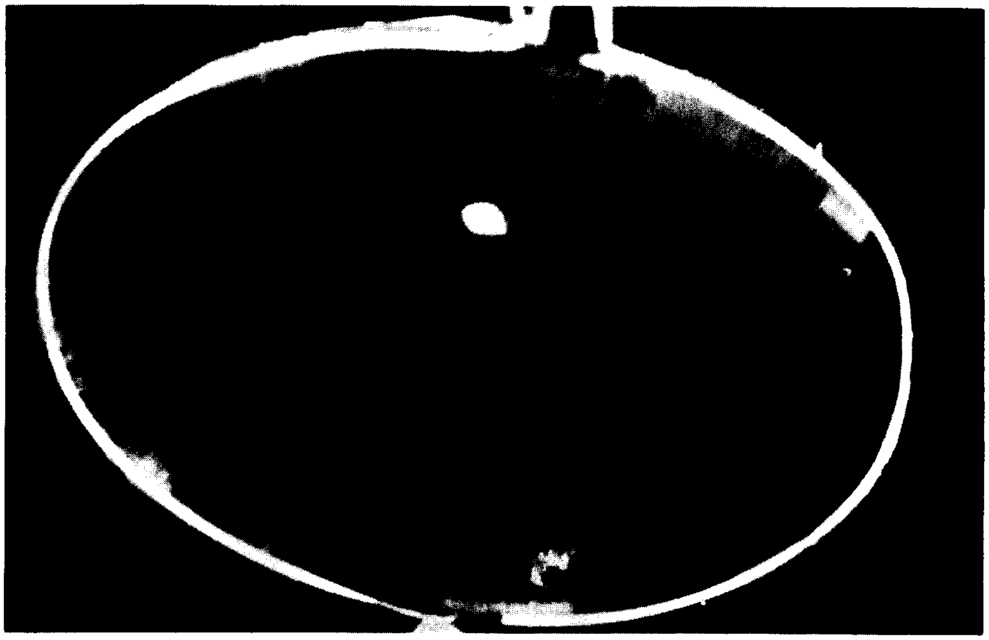


Figure 11 SYNTHETIC BLACK OPAL

The most distinctive characteristic of synthetic opal is its structure. It usually has a good play-of-color in a mosaic pattern across its surface. Inside the mosaics, there is a cellular, snakeskin or scale-like structure. "Chicken wire" is another term used to describe this structure, because it's almost as if the mosaics have an overlay of fine chicken wire across them. Although this structure is visible in both black and white opal, it is not easily seen in the synthetic white material because of the lack of contrast.

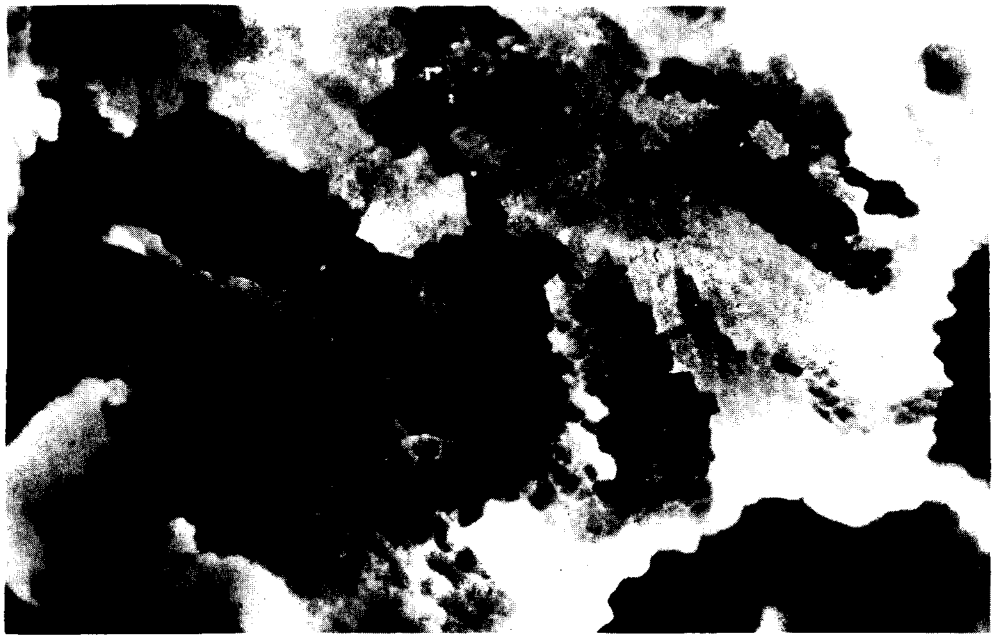


Figure 12 THE SNAKESKIN OR SCALE-LIKE STRUCTURE OF SYNTHETIC BLACK OPAL.

In synthetic black opal, this structure is visible under magnification when the stone is illuminated with overhead lighting. You may also want to look for it with back lighting. To backlight a stone, turn the iris diaphram of the microscope down to an opening that is just covered by the cabochon. Then open the baffle at the bottom of the light well to achieve a bright background.

As with most synthetics, the properties of synthetic opal are very consistent with the properties of natural opal. For reference purposes the properties of synthetic opal are summarized below.

SYNTHETIC OPAL PROPERTIES:

Chemical Composition	$SiO_2 . nH_2O$		
Hardness	about 5½		
Specific Gravity	2.00 ± .03		
Transparency	Translucent		
Refractive Index	1.44 & 0.01		
Color	White, black		
Fluorescence	White -	X-Ray -	None
		SW UV -	Moderate to strong blue to yellow; no phosphorescence
		LW UV -	Moderate blue to yellow; no phosphorescence
	Black -	X-Ray -	None
		SW UV -	Weak to moderate yellow; no phosphorescence
		LW UV -	None
Phenomena	Play-of-color		
Inclusions	None		

Gem opal is so distinctive in appearance that it is usually possible to distinguish it from other species or imitations on sight. Of course the existence of play-of-color does not mean that the entire stone is gem opal. Always consider the possibility that the stone is a doublet, especially if the mounting covers the girdle. If a doublet is unmounted, it is easy to see the separation line where the opal top is cemented to the back, but it may be impossible to detect a doublet in a gypsy style setting and very difficult to detect one in any mounting that conceals the separation plane.

If the back of the mounting is open and a strong play-of-color is visible, a doublet is unlikely, since the usual backing material is either chalcedony or potch opal. An absence of play-of-color through the back of the bezel suggests a doublet or possibly a solid opal with fine gem material confined to a thin seam at the top of the stone. An opal in which the top portion is fine quality and the lower portion is potch is much less valuable than a stone that is fine quality from top to bottom. If the separation plane can not be seen, doublets in which the base is common opal may sometimes be detected by using a strong transmitted light such as exists when the baffle is opened and the diaphragm stopped down in a microscope. Gas bubbles or separations in the cement will reveal the doublet. In certain cases, it may be necessary to unmount the stone in order to identify a doublet positively.

The adhesive used to cement a thin seam of fine white or black opal to a low grade of opal is almost always black. The thicker, low grade white opal back is too opaque to be affected by the pitch, thus, if a mounted stone appears to be black opal from the top and white from the base, it is probably a doublet. Most colored stone imitations which have a layer of colored cement between two pieces of material are called triplets. In the case of opal, however, the term triplet is used to describe assembled stones consisting of a rock crystal quartz, or glass top, a thin seam of opal, and a bottom layer of a harder protective material possibly chalcedony or potch.

An opal triplet presents no difficulty to the tester. Viewed from the side and unmounted, the three separate layers are clearly visible. Even when mounted with the bezel completely enclosing the girdle, the lack of play-of-color on the bottom plus transparency of the top portion when viewed from the side will identify it (figure 13).

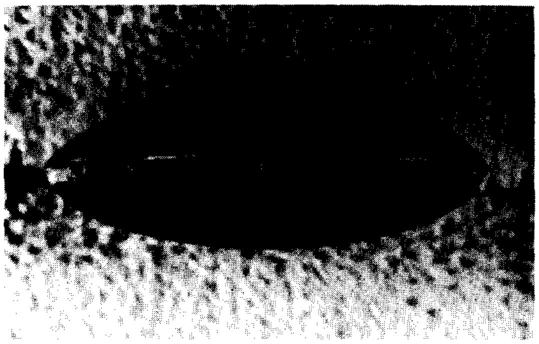


Figure 13

Specific gravity tests are rarely necessary in opal identifications. Although a hydrostatic diamond balance determination does no permanent harm, heavy liquids could damage the relatively porous gem opal; thus, heavy liquid tests should be avoided.

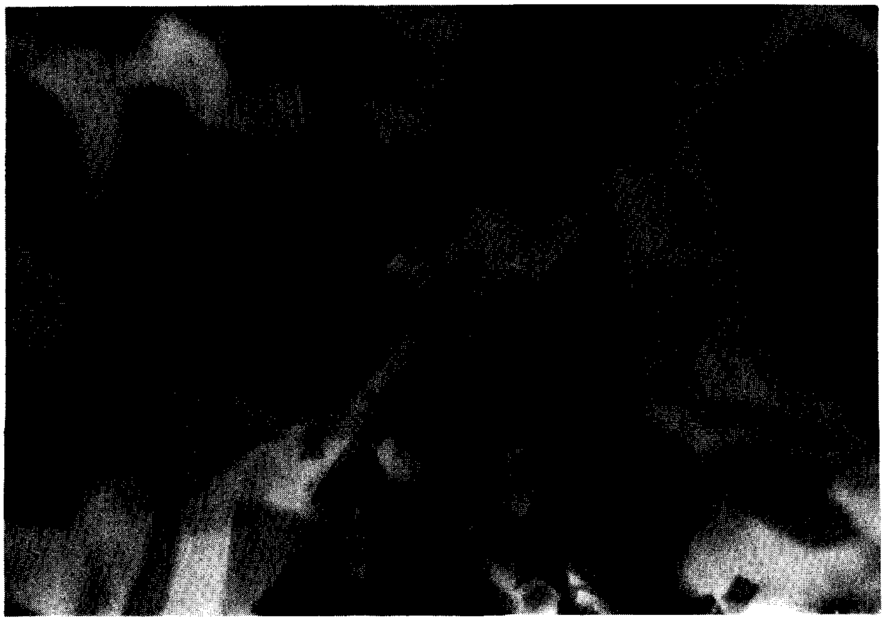


Figure 14 UNDER MAGNIFICATION THE COLOR PATCHES IN SLOCUM STONE LOOK LIKE PIECES OF CELLOPHANE.

Opal imitations have been made by sandwiching an iridescent metal foil between layers of glass that has not yet congealed and then contorting the glass to give the foil a broken, irregular surface. The imitation is so poor that it is easily detected by eye. Another imitation is formed by embedding fragments of mother-of-pearl or abalone shell in a clear plastic or glass. This, too, is readily detectable by eye for what it is. "Slocum stone" is a name used for another somewhat more effective glass imitation. Under magnification the play-of-color in "Slocum stone" resembles bits of transparent, colored cellophane scattered randomly throughout the stone.

A very realistic plastic imitation from Japan, closely resembles transparent to translucent opal with play-of-color. This material cannot be visually separated from opal; however, its S.G. is much lower than opals and it is much softer than opal. The most reliable test is to press a pin gently into the stone in an inconspicuous spot while examining it under magnification. The pin will indent the plastic imitation but it will usually not indent natural opal. The exception is extremely porous natural opal which may be indented by the pin. This opal can be distinguished by its characteristic appearance and the fact that it is so porous it will soak up water.

Fire agate is a natural stone that may resemble opal, at least to the novice. It is an iridescent variety of brown chalcedony. Once you are familiar with its appearance, you should have no trouble distinguishing it from opal visually. It's body color is always brown, and although iridescence and play-of-color are similar phenomena, they can be distinguished from each other on sight. In addition, the R.I. of chalcedony is 1.535-1.539 and its S.G. is also much higher (2.60).

Labradorite is another natural stone that may resemble gem opal. Usually, labradorite exhibits a single hued labradorescence over the entire top surface of the stone at any one angle of observation. The color changes as the angle of view changes. To one who is familiar with gem opal, the resemblance to play-of-color is not close. In anorthosite, a labradorite rich rock, the individual grains are smaller and the rock is often black; therefore, the similarity to black opal is somewhat closer, but still far from identical. Anorthosite is used as a decorative material on interior and exterior building facing, counter tops, etc. Since labradorite has excellent cleavage, its breaks are usually flat, whereas any fractures that are visible on opal will be conchoidal and exhibit a vitreous luster. The low specific gravity of opal also serves to identify it.

Oolitic opal is the only natural opal resembling the sugar treated. Its dark body color is produced by small individual brown or black spheroids, each surrounded by a lighter background or play-of-color (figure 15). Under low magnification, these inclusions are circular and unlike the tiny black specks filling the cracks of sugar treated opal. Once you become familiar with the appearance of these two materials you should have no difficulty in distinguishing between them. Very rarely, sugar treated oolitic opal has been encountered, in which case both characteristics are visible on the same piece.

The terms Mexican opal, cherry opal, and fire opal have been used to describe the transparent orange to orange-red variety. This could be difficult to distinguish from glass, except that the usual refractive index of glass is different from the usual R.I. of gem opal. Usually, gem-quality opal has an R.I. of 1.41-1.45 which is somewhat lower than the lowest range of R.I.s of the glasses used for gem imitations. Transparent opal usually has an R.I. that is distinctly lower than most gem opal — in the 1.37 to 1.43 range. Since transparent glass is not likely to have an index below

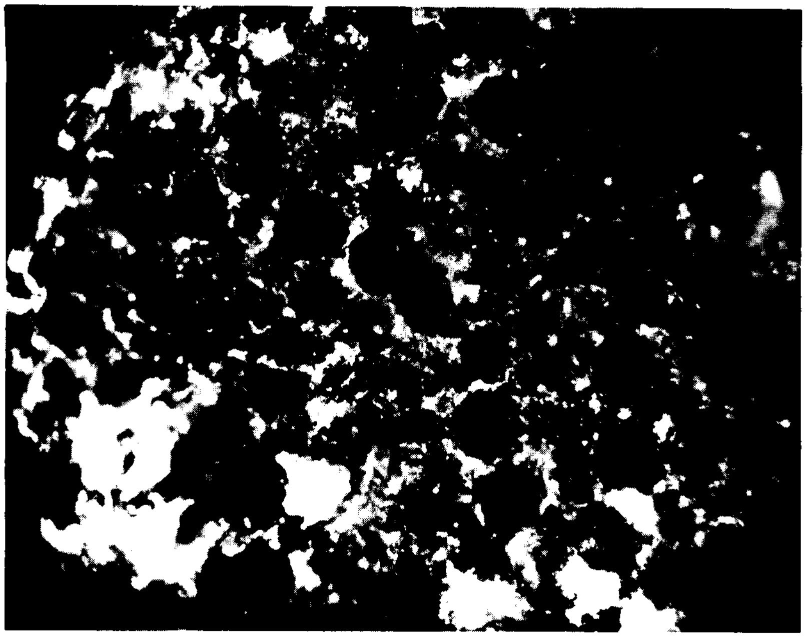


Figure 15

1.47, this is a significant difference and a satisfactory means of identification. Plastics such as bakelite may also resemble fire opal, but they too have distinctly higher refractive indices.

Semitransparent to opaque opal entirely without play-of-color is known as common opal. Some types of this material closely resemble various chalcedony varieties such as chrysoprase. Since opal may be partly crystallized, it sometimes appears light in the dark position of the polariscope and otherwise approaches chalcedony in properties. Since silica and chalcedony both have a water content, opal may be considered by some to grade into chalcedony as its degree of crystallization increases. However, there seems to be no gem opal with properties overlapping those of chalcedony.

B. DETECTION OF TREATMENT

Smoke treated black opal can be identified by its low R.I. (1.38 to 1.39), very porous nature, and by the slight rounded indentation (not a chip) that occurs when a pinpoint is pressed gently against the surface in an inconspicuous spot. When the stone is touched to the tongue, the extreme porosity will cause it to stick to the tongue and the moisture will turn the stone black where touched. The blackness goes away and the play-of-color returns as the spot dries. S.G. is variable but very low, some material even floats on the water until it soaks it up.

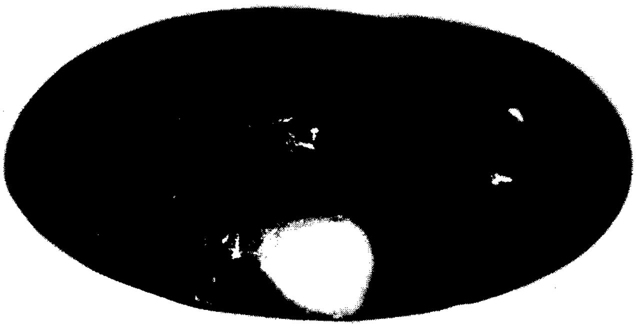


Figure 16 NOTE THE DIFFERENCE IN COLOR AND THE SHALLOW PENETRATION OF THE TREATMENT WHERE THIS "SMOKED" OPAL HAS BEEN CHIPPED.

Sugar treated black opal may be separated from natural black stones by using magnification and an overhead light source. Under magnification, the stone teems with black specks resembling black dust, resulting from carbonized sugar filling tiny cracks between gray or cloudy white patches. Play-of-color appears in a mosaic pattern and seems to come from near the surface of the stone (figure 17).

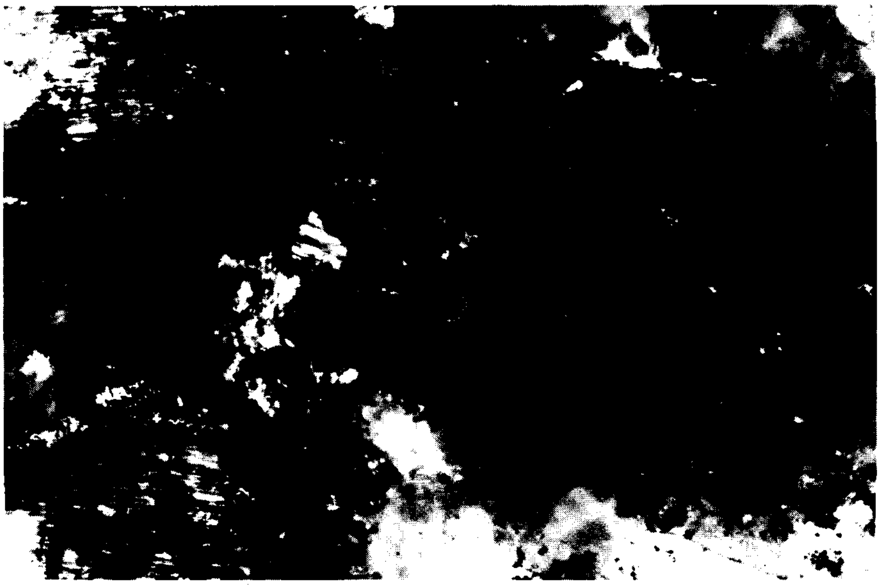


Figure 17

Plastic treated opal is distinguished from natural opal primarily on the basis of appearance. Plastic treated black opal is much more transparent than most natural black opal and has inclusions that are somewhat like the inclusions seen in flux-grown synthetic emerald. They are dark inky looking wisp-like or veil-like inclusions in an otherwise transparent material.

VIII. EVALUATION

The value of an opal is based on three principal characteristics: (1) the intensity of the colors, (2) the distribution of the colors, and (3) the number of colors present and their relative abundance. An ideal stone is semitranslucent with the play-of-color consisting of individual patches of colors varying in hue, one from the other, and each large enough to be visible individually at normal arm's length.

Roughly, the order of desirability of play-of-color in black or white opal is red, violet, orange, yellow, green, and blue. On the other hand, in Mexican opals, violet, green, and blue are the most sought for colors since they contrast most strongly with the usual body colors of yellow, orange, and red.

If desirable colors such as red, violet, or orange are present, the opal is much more valuable. Stones in which the above colors are of rather low intensity and distributed in only a few areas are usually less expensive, whereas those with a predominance of red and violet flashes of medium intensity will cost more. Opals with a variety of intense colors, including red and violet, are usually among the most expensive depending on the size and shape of the stone as well as the overall impression the stone makes.

The wholesale PER CARAT value of white opal varies considerably. Fine stones in any size are rare. Unfortunately, the majority of stones on the market are gray or milky. Matched stones (i.e., those similar in appearance) may be offered at prices above those expected of single stones. Low-quality white opals cut to standard mounting sizes may be inexpensive and priced on a per stone basis; these show little play-of-color and only in streaks and small patches.

As a rule, the cross-section shape is less important for opal than it is for other phenomenal stones, such as star sapphires. Opal rarely occurs in pieces that are thick enough to yield high cabochons, and even when they do, such shapes are usually avoided since the maximum play-of-color is usually obtained when the surface is parallel to the platy areas that produce play-of-color. In better quality opals, these areas are usually in parallel or nearly parallel planes; thus, a high cabochon would reduce the beauty of such a stone. In addition, two flat cabochons of fine quality could be cut from a piece of rough thick enough to yield a high cabochon.

The girdle outline of an opal is much more important. Oval shapes are the most popular although fancy shapes such as triangles and squares, if in pairs, rate equally with ovals of similar weights. Opal is cut in baroque outline cabochons more frequently than other materials since these shapes may be cut to conserve weight and follow the areas that have a fine play-of-color.

When you are buying opal for stock, always consider the thickness of each stone. Many opals sold today are much too thin to be used in jewelry.

Opal doublets are judged on the same basis as solid opals except for the following considerations. They are most logically sold on a PER STONE basis rather than on a per carat basis, since the backing usually weighs several times as much as the gem-quality portion. The thickness of the gem portion is another factor in determining value. A doublet with a thin opal top is quite fragile, and only a slight bump or a little pressure can cause it to crack. Floating opal and stones made by cementing opal pieces into black chalcedony are relatively inexpensive.

IX. BUYING AND SALES ASPECTS

Opal is one of the all time favorite gemstones. Many people think it is the most beautiful of all phenomenal stones. It's also a surprisingly versatile stone; its flashing colors appeal to every age group and its many forms are suitable for almost all hair and coloring combinations. Opal is one gemstone that looks good on almost anyone. But it has to be seen and worn to be appreciated.

More than with many other gemstones, its easy to educate customers about the differences in quality and prices of opal because the finer stones are much more beautiful than average qualities. When you compare finer qualities with lower qualities, customers easily appreciate why one stone is more valuable than another.

Unfortunately this also means that the finer qualities have to be seen to be appreciated. With some stones, for example, ruby, emerald, and sapphire, you can sometimes tell a customer that you'll get a finer quality stone in to show them and still feel reasonably confident about closing the sale. But its hard for most people to visualize what fine quality means with opal. They have to see the stone to really appreciate it. For many jewelers, the secret of selling opal is keeping a selection of attractive stones on hand and showing them whenever possible.

There are a wide variety of opals and a wide variety of price ranges. Many people think of opal as either black or white and are unaware that opal has a range of body colors. Some jewelers have created striking jewelry using colored stone melee to highlight an opal's body color or the predominant hue in its play-of-color. Many jewelers overlook the brilliant orange Mexican opal that has a strong play-of-color. These stones can make spectacular jewelry pieces when mounted with orange colored stone melee or with yellow gold accents.

Opal's major drawback is that it is fragile. Since it is soft, and its toughness is poor, it is easily scratched, broken, and chipped. This does not mean that it's a poor gemstone; but it is one stone that must be handled with care. It is always important to teach customers to care for their jewelry, but it's especially important if they are buying an opal. You can do this without alarming your customer or over dramatizing the issue. Many jewelers compare wearing an opal to wearing a fine dress. "One simply doesn't do gardening in it." Other jewelers introduce the subject jokingly with "And now let's talk about the care and feeding of an opal." Caution customers about rough wear and advise them to keep their opals from rubbing or hitting against other jewelry in their jewelry box. In general, opal is not a stone for men's jewelry although it can be used in tie tacks and possibly cuff links. Opal doublets and triplets are a good option for men since they are much less likely to be damaged by rough wear.

One prevalent myth in the jewelry industry is that soaking an opal in a liquid such as water, glycerin, or oil will keep it from drying out and crazing. Unfortunately this is an old wives' tale. The liquid will mask existing cracks, but there is no evidence that it will protect a stone from further crazing.

The major reason this myth has persisted for so long is that soaking a crazed or poorly polished opal in a liquid temporarily improves the stone's appearance. The liquid conceals cracks that are already present because its R.I. is close to the R.I. of opal. However, once the liquid dries out or is rubbed off, the cracks reappear. Soaking an opal in a liquid may also temporarily improve the appearance of the stone's polish. Since opal is soft, it will get "scuffed" with wear; coating such a stone with a liquid will make it look freshly polished. However, the improvement is only temporary. A more permanent solution is to repolish the stone. As mentioned earlier, in many cases this can be done without removing the stone from the mounting.

Although some jewelers have displayed opals in their store windows without any problems, it is wisest to avoid putting opals under such hot lights. High heat or a sudden change in temperature could cause an opal to crack. An in-store display is a much safer bet. Because opals are gemstones that often "grow" on people you should draw attention to them whenever possible. Many jewelers remember instances when a customer came back again and again to look at an opal before deciding to buy it.

Opal is the October birthstone and, of course, this is an excellent time for a major promotion. Because many people are interested in opal sources and most people associate opal with Australia, a display featuring information on Australia and Australian opal mines will catch the eyes and imaginations of many customers. People

Figure 18

are fascinated with the story of opal. A good size piece of potch with a thin seam of opal (too thin to be used for jewelry) makes a wonderful prop for an opal display (see figure 18). This material might be available at trade shows or more likely at gem and mineral shows and can be the focal point of your opal displays for years.

Never bring up the subject of opals being unlucky unless your customer does. If someone does ask you about it, there are several approaches that other gemologists have used successfully. Wilfred Charles Eyles in his *The Book of Opals* reports that he once asked a famous gemologist if opal was unlucky. The answer was "It certainly is. It is very unlucky if you are unfortunate enough not to have any." Another gemologist referred to the *Anne of Geierstein* novel when he would say "Opal is only bad luck for bad girls."

The bad luck superstition about opal seems to have had a number of origins. The *Anne of Geierstein* novel was one factor, but it was probably minor. There are reports that buyers in Australia started rumors that opal was unlucky in hopes of driving off the competition so that they could buy the fine stones for themselves at low prices. Needless to say, the scheme didn't work. Actually opal has always been considered lucky in Australia, particularly among opal miners.

It is also possible that Hungarian opal dealers started a publicity campaign to discredit the newly discovered Australian opals in the same way that dealers had tried to discredit Brazilian diamonds when they were discovered. Instead of saying that the new stones were softer and inferior in quality as dealers had said about Brazilian diamonds, they may have tried to sabotage the Australian opal industry by claiming that Australian opals were unlucky.

Whatever its source, you should always be careful how you react to a superstition. Few people will admit it and some may even become defensive about it, but most people are slightly superstitious. Be careful not to make fun of a customer or put him on the defensive. An easy going light tone is probably your best bet.

Few jewelers need to be told about opal's popularity, most regard it as a jewelry store staple. The variety of intense colors of opal and its ever changing appearance under different lighting conditions never fails to fascinate people. Few stones have as much individuality as a fine opal. Thus in spite of it's fragility and in spite of the superstitious surrounding it, opal has emerged as one of the top selling gemstones of all times. And it will remain a top seller for those who treat it with care and show it with enthusiasm.

OPAL

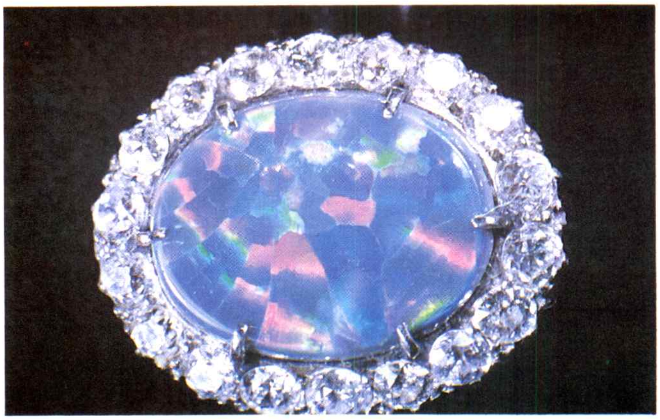


Figure 1

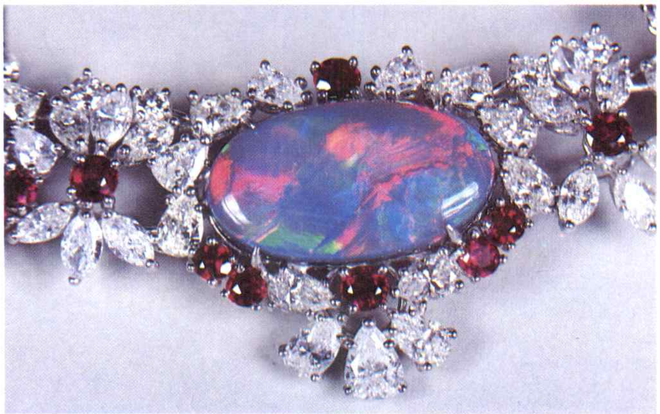


Figure 2

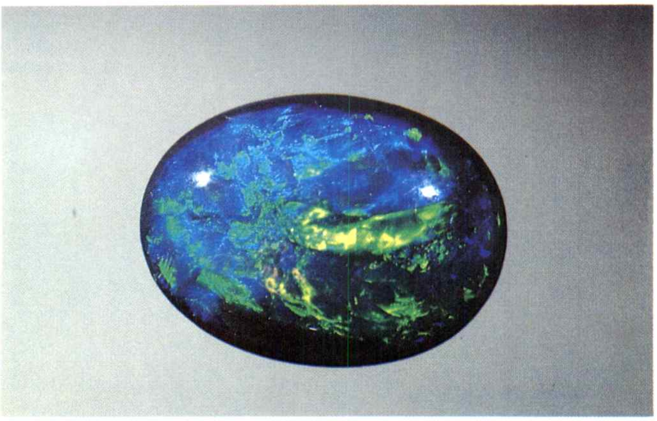
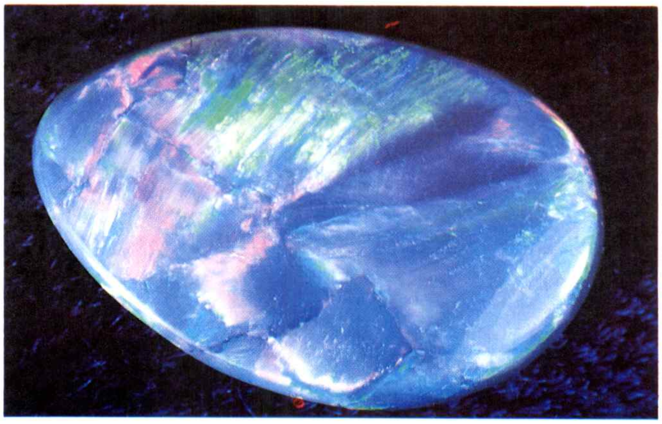


Figure 3



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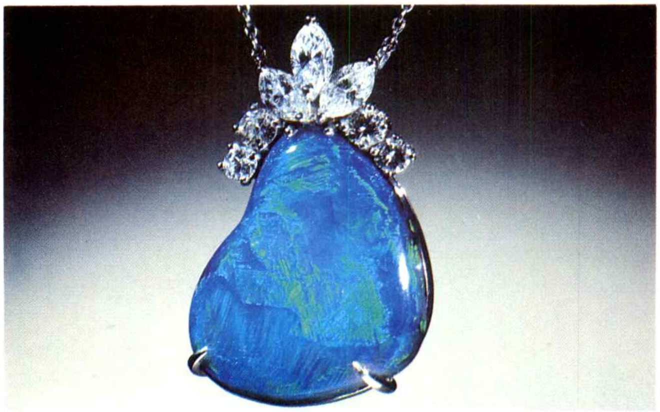

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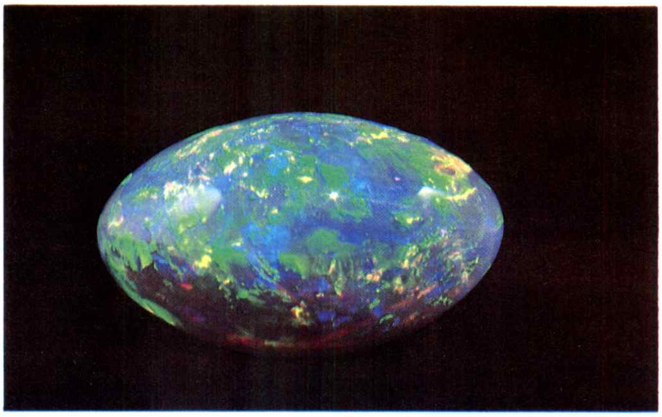
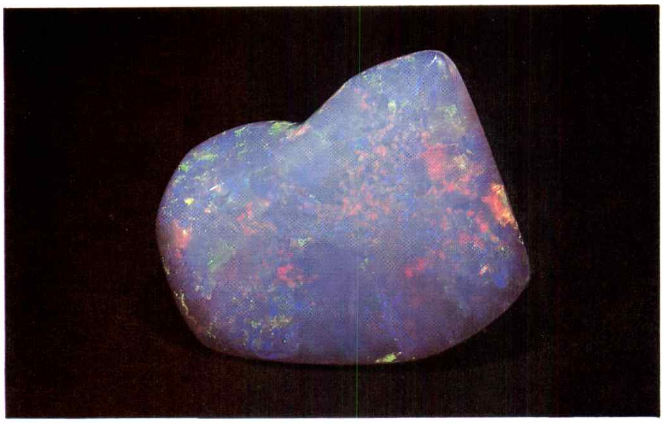


Figure 6

OPAL



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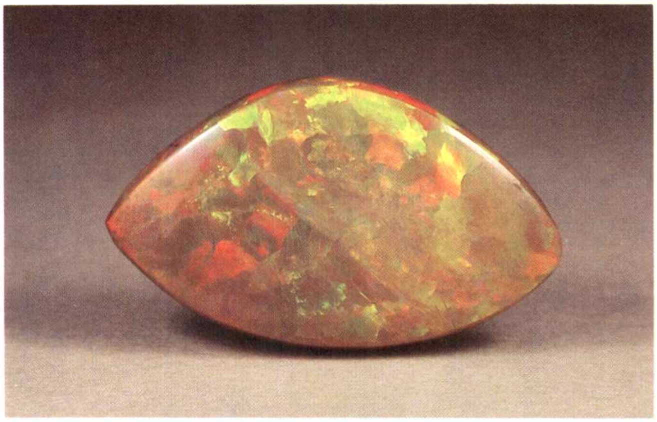

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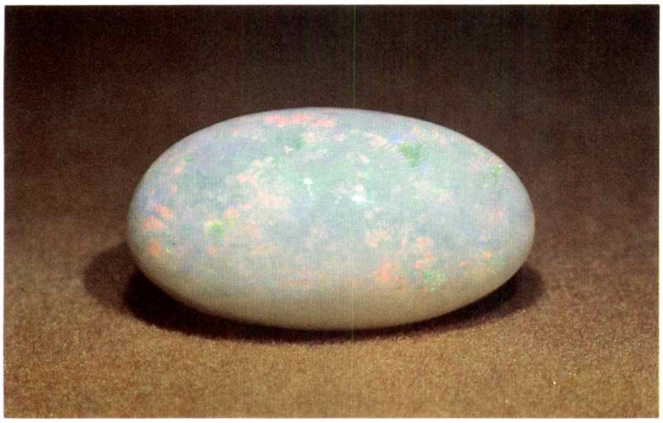


Figure 9

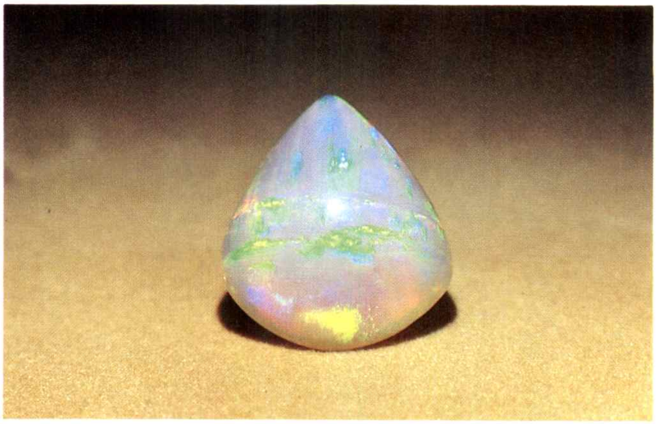
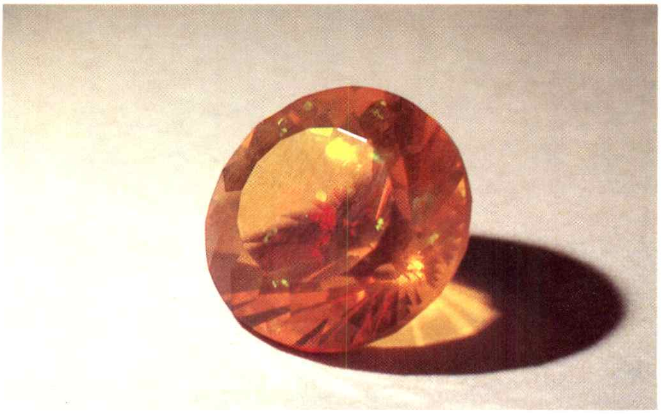


Figure 10



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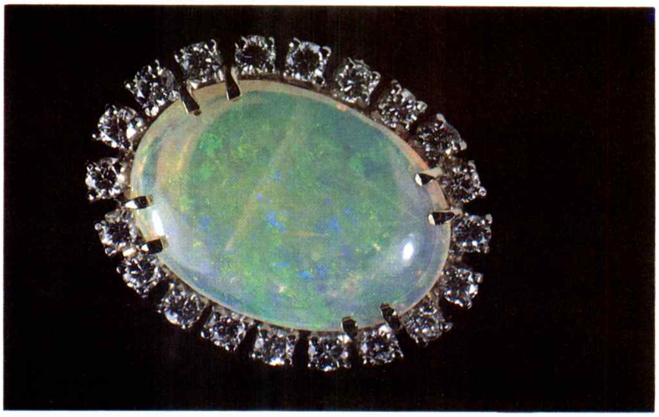

Figure 12

OPAL

Figure 1	Australian black opal with play of color in a harlequin pattern. The clearly defined pattern and the predominance of red in the play of color make this an exceptional stone.
Figure 2	This Australian black opal was set with rubies to accentuate the red tones in its play of color. When the play of color occurs in sudden flashes like this, the stone is called flash opal.
Figure 3	Blues and greens predominate in the play of color in this black opal from Australia. Generally, in terms of rarity and value, the most sought after hues in an opal's play of color are red, violet, orange, yellow, green, and blue (in this order).
Figure 4	This Australian black opal is called flame opal because of the sweeping reddish bands in its play of color. When judging the quality of the play of color, look for a number of colors and an even distribution; also note the relative abundance and intensity of these colors.
Figure 5	Australian black opal with a blue and green play of color. In addition to having an attractive play of color, opals should have a pleasing shape, usually oval or some variation, and they should be thick enough to mount securely.
Figure 6	Reds, yellow, blues, and greens play within this black Australian opal. Note the variety of colors and the evenness of their distribution.
Figure 7	In addition to its well defined play of color and translucency, this white Brazilian opal is also noteworthy for its size: it weighs more than 200 carats.
Figure 8	An example of American opal: this stone was found in the Virgin Valley of Nevada. The evenly distributed play of color contrasts with the orange body color to make an unusual and unique gem.
Figure 9	White opal from Australia. The term pinfire describes the small patches or pinpoints of color seen in this stone.
Figure 10	This opal from Brazil is referred to as "crystal" opal because of its transparency and distinct play of color. This combination of characteristics is rare and highly valued.
Figure 11	Faceted fire opal from Mexico.
Figure 12	This Australian stone is an excellent example of crystal opal. The transparency of the material is especially apparent near the edges of the stone.